Locomotion and Movement

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* Introduction

· Locomotion
÷ change in location of body

· Movement
÷ change in body posture

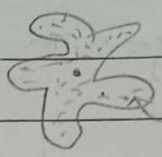
* Purpose of locomotion
· In search of food, water, shelter, mating
· To escape from unfavourable environmental condition, predator ~~ee~~ etc.

note÷ All locomotions are movement but not all movements are locomotion.

· Types of locomotion depends on÷
(a) Habitat (b) Demand of situtation
example of different locomotion ÷ running, walking swimming, climbing etc.

* Types of movement
There are four types of movement
(1) Amoeboid movement (2) Ciliary movement
(3) flagellated movement (4) Muscular movement

* Amoeboid movement
→ formation of pseudopodia (false feet)
→ Due to streaming of protoplasm
→ Cytoskeletal element like microfilament play important role.
ex: leucocyte, Macrophage } in human
Amoeba



Amoeba

* Ciliary movement

→ Cilia present on ciliated epithelium provide undirectional movement of particle.

eg: removal of dust in trachea, movement of ova in fallopian tube/oviduct)

* Flagellar movement
→ movement of particle due to flagella,
eg: sperm, water canal system in sponges/ porifera euglena.

* Muscular movement

→ Movement of limbs, jaw, eyelid etc in human is done by muscular movement

→ Also it help in locomotion (voluntary movement)

note: Locomotion require cordination of ~~muscle~~ muscular, neural and skeletal system.

* Types of muscle

→ There are three types of muscle

(1) Skeletal muscle
- voluntary
- striated
- attatched to bone
- eg. walking

(2) Smooth muscle
- Involuntary
- unstriated (smooth appearance)
- In visceral organ

eg: Alimentary canal, reproductive tract

(3) Cardiac muscle
- Involuntary
- striated, branched, intercalated disc present
- only in heart

* Muscle
- mesodermal origin
- 40-50% of body weight (adult human)
- 639 in number
- 4 properties :-
(i) Excitability (common property of neuron and muscle)
(ii) Extensibility
(iii) Elasticity
(iv) Contractility (Muscle can contract)

* Structure of muscle

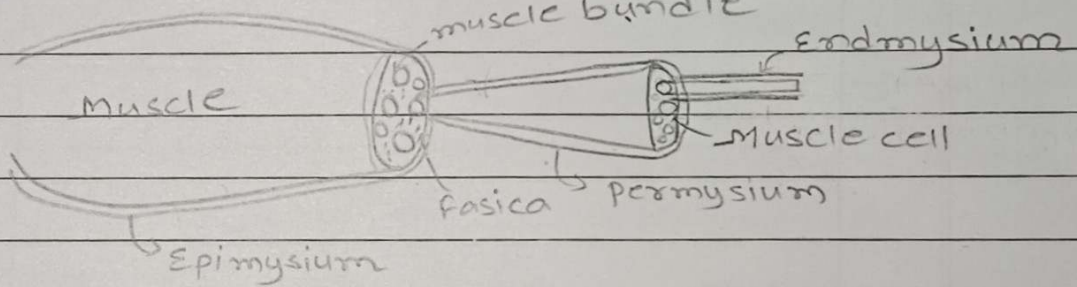
Each muscle
↓ made of many
Muscle bundle or fascicle
↓ made of many
Muscle fibre/cell

- Covering of muscle :- Epimysium
- Covering of muscle bundle :- perimysium
- Covering of muscle fibre :- Endomysium

- Fascicles are held together by collagenous connective tissue called fascia

- plasma membrane of muscle fibre ÷ Sarcolemma
- Cytoplasm of muscle fibre ÷ Sarcoplasm
- Endoplasmic reticulum of muscle fibre ÷ sarcoplasmic reticulum (storehouse of Ca^{2+})

note÷ Sarcoplasm ~~han~~ has many nuclei (syncitium)
Sarcoplasm has parallely arranged myofibrils or myofilaments.



* Myofibril / Myofilament

- It has two protein alternatively arranged, giving straited appearance.

(i) Actin
→ thin filament
→ form I band * or light band

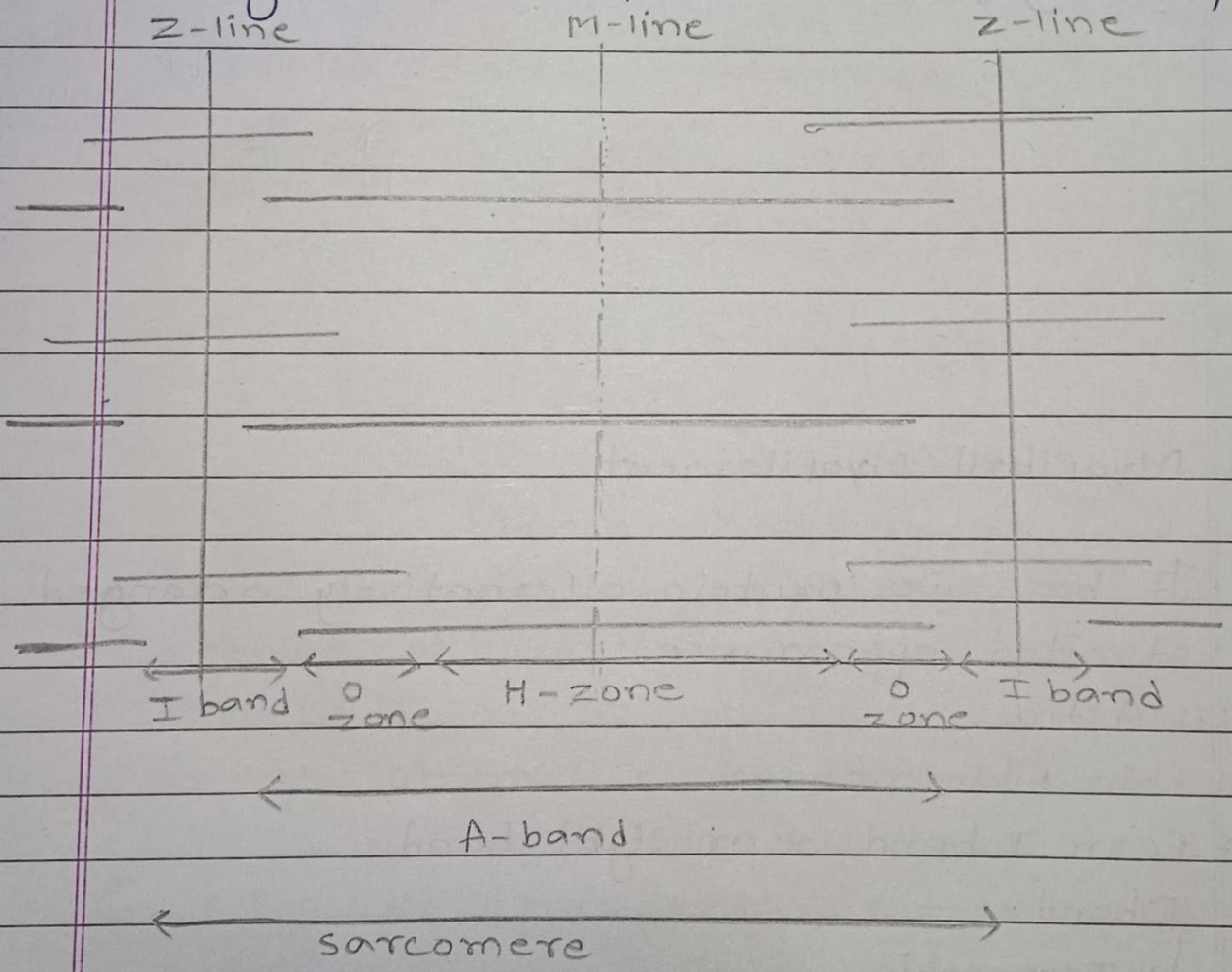
I band
↳ Isotropic

(ii) Myosin
→ thick filament
→ form A-band or dark band

. A band
↳ Anisotropic

. Sac Sarcomere
→ functional contractile unit
→ portion b/w two successive Z-line

. During contraction, actin slide over myosin

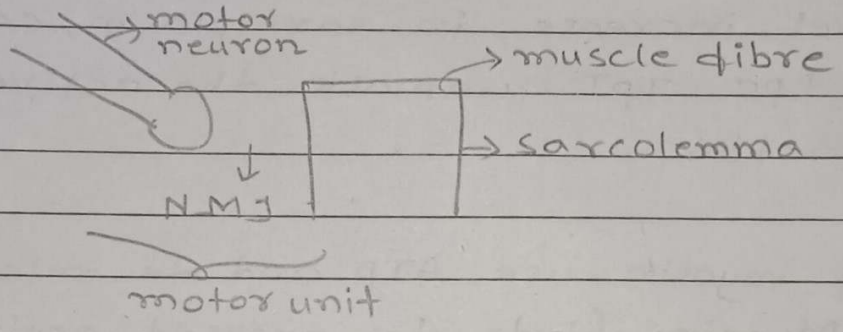


- During contraction :-
  length of I band decrease
  length of sarcomere decrease
  length of A-band same
  length of O-zone increase
  length of H-zone decrease
  length of actin same
  length of myosin same

* Mechanism of muscle contration

- Neuro-muscular junction (Motor end plate)
  ÷ Junction b/w motor neuron and sarcolemma of muscle fibre.

- Motor unit ÷ Motor neuron along with its muscle fibre form motor unit.



* Steps involved in muscle contraction

(a) CNS send impulse to motor neuron

(b) Impulse arries at axon terminal, causing opening of ca^{2+} channel, ca^{2+} moves from outside to inside.

(c) ca^{2+} will cause exocytosis (out of cell) of neurotransmitter (acetylcholine)

(d) Neurotransmitter bind to its ~~receptor~~ recepter present on sacrolemma of muscle fibre

(e) Action potential generate in muscle fibre causing release of ca^{2+} from sarcoplasmic reticulum.

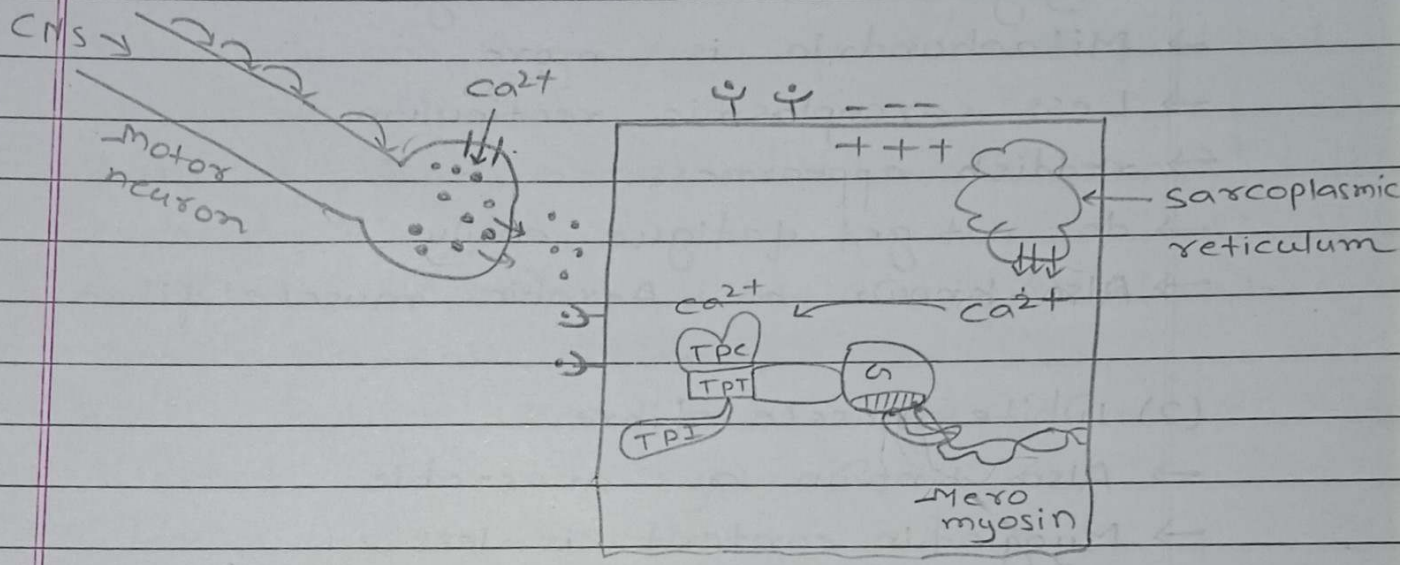
(f) Ca^{2+} level increase in sarcoplasm, ca^{2+} bind to tpc, TpI unmask the active site of action

(g) Head of myosin use ATP and ~~de~~ release energy. Myosin binds to exposed active site of actin and pulls it causing contraction. Hence length of sarcomere decreases

(h) As ATP is hydrolyse and ADP bind to head of actin, myosin unbinds with actin.

note: Myosin bind with actin → formation of cross bridge
Myosin unbind with actin → breaking of cross bridge

(i) New ATP bind to head of myosin, causing formation of new cross bridge. This process continues untill relaxation.



* Mechanism of Relaxation

- Ca^{2+} pumped back to sarcoplasmic reticulum
- No Ca^{2+} binding to TpC
- TpI mask active site of actin. Hence head of myosin can't bind to actin
- No sliding of actin over myosin. No contraction (Relaxation)

* Musle fibre
→ two type
(1) Red muscle fibre
→ Myoglobin content is high
→ Mitochondria is more
→ Less sarcoplasmic recticulum
→ reddish appearness
→ do not get fatigue easily
→ Also known as Aerobic muscle fibre

(2) White muscle fibre
→ Also known as anaerobic
→ Myoglobin content is less
→ Mitochondria is less
→ More sacrcoplasmic reticulum
→ get fatigue easily
→ pale/white appearance

note ÷ Myoglobin is O_2 storing protein.

* Skeletal system

- Skeletal system provide framework to body
- It includes bone and cartilage
- Bone and cartilage are ~~specillised~~ specilised connective tissue.
- Bone is hard, non-pliable matrix, ca^{2+} salt present
- Cartilage is solid, pliable matrix, ~~chondrocyte~~ chondrotin salt present
- Adult human has 206 bones which is divided into two system.

(i) Axial system → 80 bones
(ii) Appendicular system → 126 bones

* Axial system (80 bones)

- Divide into four parts

(1) Skull and its associated bone (29)
↳ 22 ↳ 7

(2) Sternum (1)

(3) vertebral column (1)
→ 26 verbrae

(4) Ribs
→ 12 pair/24

* Skull (29 bones)

(1) Cranial bone
→ form cranium/brainbox
→ 8 flat bones
- frontal bone (1)
- parietal bone (2)
- temporal - bone (2)
- Occipitial - bone (1)
- Sphenoid - bone (1) → Butterfly shape bone
- ethmoid - bone (1)

(2) facial bone (14)
→ form framwork of face
- Mandible (1) → lower jaw
- Maxillae (2) → upper jaw
- Vomer (1) → triangular bone
- Zygomatic (2)
- Nasal (2)
- Inferior nasal chamber (2)
- Lacrimal (2)
- palatine (2)

(3) Hyoid
→ single bone, U shaped bone
→ At base ~~of~~ of buccal cavity
→ tongue attatched to it
→ Doesn't articulate with other bone

(4) Ear ossicles

→ In middle ear three bones known as ear ossicles are present

- Malleus
- Incus
- Stapes

* Sternum

- one in number
- also known as breast bone
- In ventral portion
- short, flat bone
- Ribs attatched to sternum ventrally.

* Ventral column

- Dorsal in position
- made by 26 serially place vertebrae ~~which formed~~
- Each vertebrae is hollow in center which formed neural canal through which spinal cord passes.

- function of vertebral column

(i) ~~proc~~ protects spinal cord

(ii) Ribs attatched to thoracic vertebral column dorsally

(iii) form framework of trunk

(iv) muscle of back also attatched to it

- Vertebrae are divided as :-

$\underline{C_7}, \underline{T_{12}}, \underline{L_5}, \underline{S_1}, \underline{Co_1}$

↳ cervical ↳ lumber ↳ coccyx

thoracic sacrum

- Sacrum is formed by the fusion of 4 5 vertebrae.
- Coccyx is formed by the fusion of 4 vertebrae

$C_7 T_{12} S_{(5)} Co_{(4)}$.

- C_1 = Cervical 1st = atlas

C_2 = " 2nd = axis

- YES movement = atlas

NO movement = axis

- Lumber is strongest and largest vertebrae
- Our vertebral column is slightly curve.

* Ribs

- Thin flat bone
- 12 pairs in numbers
- Ribs articulated
  - dorsally with ventral column
  - ventrally with sternum

* Types of Rib

(1) True Ribs (vertebrosternal rib)

- join dorsally to ~~vent~~ vertebral column and ventral to sternum.
- 1st to 7th pair of ribs

(2) false ribs

- join dorsally to vertebral column and ventrally to 7th ribs
- 8th, 9th, 10th pair of ribs

3

(3) Floating or ventebral ribs

- join dorsally to vertebral column and do not articulate ventrally
- 11th and 12th pair of ribs

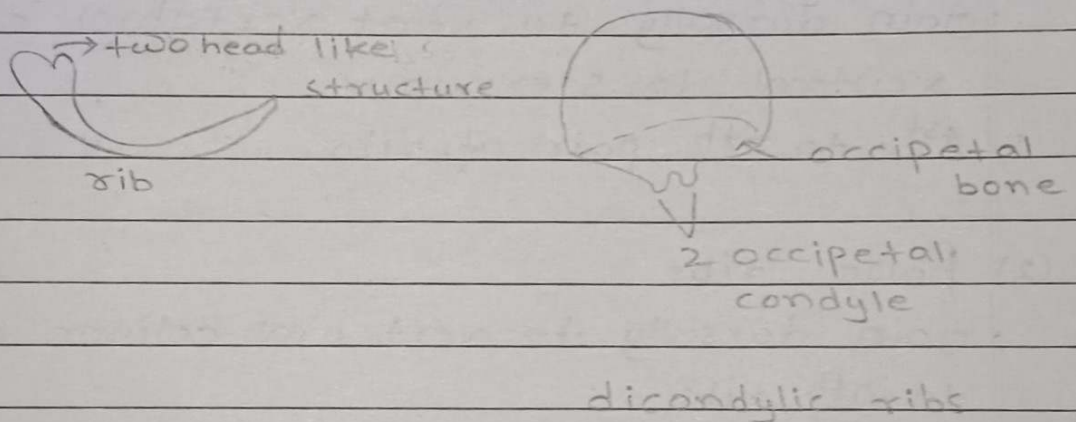
note: Hyaline cartilage help in articulation of true ribs to sternum and false ribs with 7th pair of ribs.

- Ribs are bicephalic
  - ↳2 ↳ head like structure
- two head like structure are present at dorsal end of ribs

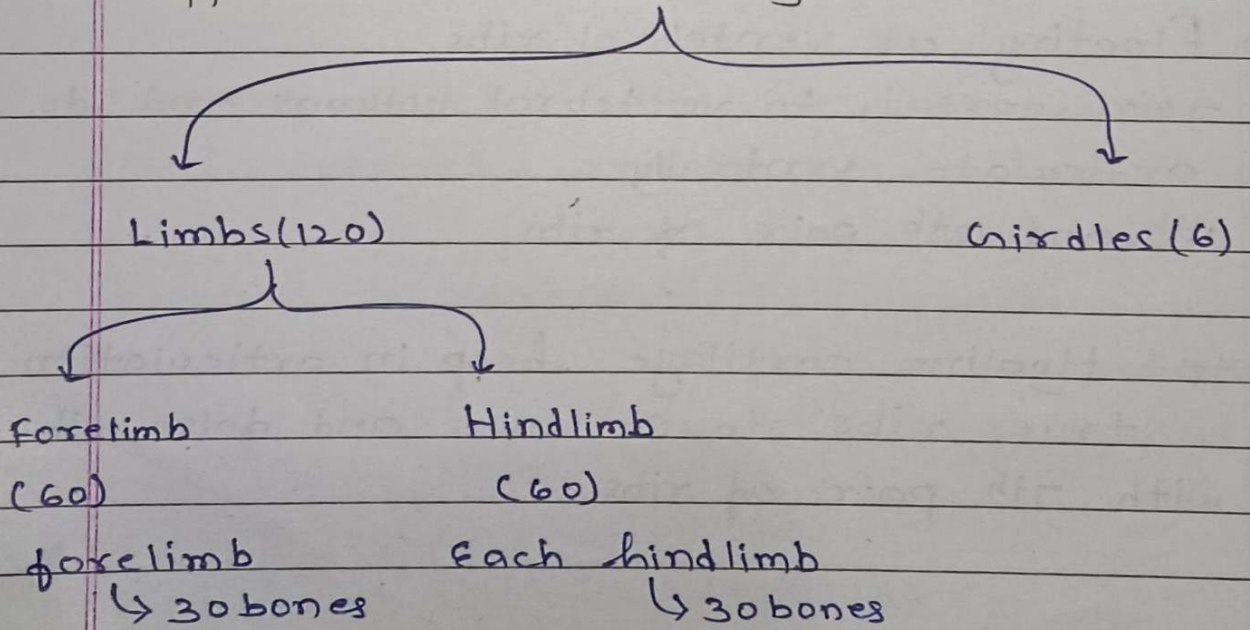
- Overall skull is dicondlic in nature
  - ↳2 ↳ condyles

(two occipital condyles is present)

- These condyles help in articulation of skull with atlas/C1



* Appendicular skeletal system (126 bones)



Girdles (6)

pectoral girdles (4)

pelvic girdles (2)

* Each forelimb (30 bones)

- Humerus (1) → arm bone
- Radius (1), Ulna (1) → fore arm bone
- Carpal (8) → (wrist bone)
- Metacarpal (5) → palm bone
- phalanges (14) → digits/fingures

* Each hindlimb (30 bones)

- Femur (1) → thigh bone, longest bone
- Tibia (1)
- Fibula (1)
- Tarsal (7) → ankle
- Metatarsal → feet
  ↳ (5)
- phalanges (digits)
  ↳ (14)
- knee cap/patella (1)
  ↳ present ventrally over knee

* Girdles (6 bones)

pectoral girdles (4) | pelvic girdles (2)

- pectoral girdles (4)

→ ~~Hep~~ Help in joining of forelimb to axial system of body

→ Each half of pectoral girdles has two bones :- (i) scapula, (ii) clavicle

- pelvic girdles (2)

→ Help in joining of hindlimb to axial system of body.

* Scapula

- large, triangular, flat bone
- In dorsal side of body
- Blw 2nd and 7th ribs (T_2 & T_7)
- has elevated ridge called as spine
- spine forms acromion process
- Below acromion process is a cavity known as glenoid cavity to which head of humerus articulates & form shoulder joint.

* Clavicle
- long and slender bone
- Ventral
- Curved bone (2 curvature)
- S-shaped bone
- Also known as collar bone/beauty bone
- Clavicle joins to acromion process

* pelvic girdle
- formed by two coxal bone
- Each coxal bone formed by the fusion of three bones: (i) ilium (ii) ischium (iii) pubis
- Both coxal bone meet ventrally at ~~public~~ pubis and form pubic symphysis (has fibrous cartilage)
- At the point of fusion of ilium, ischium and pubis a cavity is formed known as acetabulum
- Head of femur articulates with acetabulum.

* Joint
- point of contact b/w bones or bone and ~~cartil~~ cartilage
- Due to joint, locomotion and other skeletal movement is possible

* Types of joints

- There are three types of joints

(1) Fibrous joint
- immovable/no movement
- Synarthrosis

ex:- cranial bones are joined end to end by fibrous joints

(2) Cartilaginous joint
- Diarthrosis
- limited movement possible
- Cartilage is present b/w joint

ex:- intervertebral disc, pubic symphysis

(3) Synovial joint
- Considerable amount of movement
- Synovial fluid is present in synovial cavity
- amphiarthrosis

* Example of synovial joint

- Ball and socket joint :- shoulder joint, Hip joint
- Hinge joint :- knee joint and elbow joints

- Pivot joint:- b/w atlas (C_1) and axis (C_2)
- Saddle joint :- b/w carpal and metacarpal of thumb
- Gliding joint:- b/w carpals and b/w tarsals

* Disorders

(1) Myasthenia Gravis
- Auto immune disorder
- Effects neuro-muscular junction
- destory receptors present on sarcolemma
- Cause weaking of muscle, fatigue and paralysis.

(2) Muscular dystrophy
- Genetic disorder
- progressive degeneration of skeletal muscle
- lack of dystrophin protein.

(3) Tetany
- low Ca^{+2} level in blood
- rapid spasm/wild contration of muscle

(4) Arthritis

- Inflammation of joint

(5) Gout

- Inflammation of joint due to accumulation of uric crystal

(6) Osteoporosis

- Bone density decreases as Ca^{2+} from bones is released in blood.
- Causes weaking of bone, due to which chances of fracture increases.
- One of the cause is low level of estrogen
- Age related disorder